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Roman Stöllinger and Mario Holzner

State Aid and Export Competitiveness in the EU

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and Mario Holzner

State Aid and Export Competitiveness in the EU

Roman Stöllinger is a research economist at the Vienna Institute for International Economic Studies (wiiw). Mario Holzner is wiiw Deputy Director.

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Abstract

Despite the proclaimed return of industrial policy (Wade, 2012) state aid provided by EU Member States remains at a historically low level. This is partly explained by the unique institutional arrangement in the EU which empowers the European Commission to monitor and restrict state aid activities of Member States. Making use of European state aid statistics over the period 1995-2011 we employ an augmented macroeconomic export function to investigate the relationship between state aid for the manufacturing sector and Member States' export performance. With manufacturing value added exports serving as a proxy for export performance, our model suggests that a 10% increase in manufacturing aid increases exports by 0.67% for the average EU country. The result is confirmed by instrumental variable estimation. We also find that the impact of state aid on exports is increasing with government effectiveness leading to large differences in the leverage of aid expenditures to promote export performance across Member States.

Keywords: *industrial policy, state aid, value added exports, external competitiveness*

JEL classification: *F13, L52*

Roman Stöllinger and Mario Holzner[*]

State aid and export competitiveness in the EU

1. Introduction

The continuous loss of jobs in the European manufacturing sector over the past two and a half decades has revived the debate on industrial policy in Europe. This debate gained momentum since the beginning of the economic crisis in 2008 and the subsequent unresolved problems of the euro area. The fact that Member States which have maintained a larger manufacturing base fared better after the crisis intensified the concerns about the declining role of manufacturing in the European economy. The painful bursting of real estate bubbles and the ongoing crisis of the financial sector nurtured doubts in the market's universal ability to bring about an efficient allocation of resources in the economy thus leaving a potentially bigger role for governments to influence or even shape the structure of the economy. Coupled with the long-term structural shifts out of the manufacturing sector, industrial policy targeted at the manufacturing sector seems to be the order of the day[1].

At the same time, industrial policy is still regarded with considerable scepticism in Europe due to the rather disappointing experiences with government interventions in the 1960s and 1970s. Large, selective and often ill-designed backward-looking subsidies to ailing firms and sunset industries earned industrial policy a bad name (Crafts, 2010). These rather unsuccessful policy experiments, together with the internationalisation of the European economy starting in the 1980s (Owen, 2012) and the arrival of the 'Washington Consensus', induced a paradigm shift in the way industrial policy is conducted in Europe. Public interventions in favour of specific firms and sectors were increasingly replaced by framework polices and 'horizontal' policies. Despite the often heralded return (Wade, 2012) and renaissance (Reiner, 2012) of industrial policy, state aid provided by EU Member States to industry and services is at a historical low level. While subsidies amounted to about 2% of EU GDP during the 1980s (European Commission, 2011) this figure went down to about 1% in the 1990s and is currently less than half a per cent.

In this paper we exploit data on state aid granted to the manufacturing sector by 27 EU Member States over the period 1995 to 2011 in order to investigate the impact of subsidies on exports. The focus on the effect of state aid to manufacturing on the sector's export performance is grounded in the belief that exports reflects international competitiveness which is a primary objective of the EU's industrial policy strategy (European Commission,

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1 Industrial policy is not necessarily equivalent to manufacturing policy. Many proponents of industrial policy are eager to emphasise that industrial policy is to be understood more broadly, potentially targeting any economic activity or sector with high growth prospects (see e.g. Rodrik, 2008).

2010a; 2010b; 2012a). We confine the analysis to the manufacturing sector because it accounts for the bulk of Member States' exports. The high tradability of manufacturing goods implies that subsidies and other industrial policy incentives for the sector are likely to target exports. Hence, we also see a relation between our analysis and the Mill test which requires subsidies to be granted only temporarily and to induce new or additional exports by the subsidy-receiving firms and industries after the termination of the state support (see for example Kemp, 1960; Harrison and Rodriguez-Clare, 2010).

Obviously, the impact of subsidies on various economic indicators depends on the way the government support is provided. It does matter which firms in which industries receive subsidies and a common criticism of industrial policy is that governments lack the knowledge for successfully 'picking the winners', i.e. that government failure is likely due to insufficient information (e.g. Pack and Saggi, 2006; Harrison and Rodriguez-Clare, 2010). Even if governments knew which firms and industries should be supported, the actual allocation of public funds is strongly influenced by vested interests. Thus, the provision of subsidies is often more dependent on political considerations and the bargaining power of individual firms or industries than economic objectives. Typically incumbent firms and established industries are more active in rent seeking and also more successful in their lobbying activities for public support than nascent industries. Therefore, in many Member States subsidies are often granted primarily to large (and sometimes ailing) firms and 'sunset industries' as evidenced in 2008 when large amounts of subsidies were handed to carmakers all over Europe (Hufbauer and Stephenson, 2009; Francois and Stöllinger, 2009). The capture of industrial policy by vested interests is a major argument against the provision of state aid (e.g. Naudé, 2010). If such government failures were pervasive in Member States and subsidies are just windfalls gains for firms, we should find no or even a negative effect of manufacturing aid on exports.

Looking for a final verdict on whether subsidies are supportive of competitiveness would be an elusive quest. Therefore, our objective is more modest and we intend to shed light on the question whether state aid to the manufacturing sector in the way it was provided by EU Member States between 1995 and 2011 had a measurable impact on sector-level export performance. The central hypothesis which was tested in our empirical model, which is embedded in a macro-economic export function for the manufacturing sector, is that state aid is a potential policy tool for Member States to foster manufacturing exports. We also test for two additional hypotheses, i.e. that the marginal effect of manufacturing aid on exports is declining with the amount of aid provided and may eventually turn negative and that more effective governments also provide 'better' aid, in the sense that the subsidies provided have a stronger impact on export performance.

The paper is structured as follows. Section 2 briefly reviews parts of the related literature. Section 3 discusses the data followed by the presentation of the empirical strategy in Section 4. The empirical results are presented in Section 5, supplemented with some robustness checks in Section 6. Policy implications are provided in the concluding Section 7.

2. Related Literature

The theoretical literature on the use of state aid as the classical tool of industrial policy is vast. The empirical literature on state aid is scarce. There is no shortage in theoretical arguments in favour of state aid support for firms in particular circumstances. Basically all arguments have in common that they rely on some sort of market imperfections or 'system failures' if viewed from a structuralist perspective (Warwick, 2013).

One such market imperfection particularly relevant for international competitiveness is the existence of (Marshallian) intra-industry externalities[2] and the resulting possibility of latent comparative advantages. If industries differ with regard to the strength of such externalities, countries that manage to specialise in industries with strong externalities will benefit in terms of higher productivity and wages. Importantly, the existence of inter-industry externalities may give rise to multiple equilibria and a situation where a country is trapped in an unfavourable specialisation in industries without externalities (low equilibrium). Importantly, a country may end up in such a low equilibrium even though it actually has a 'latent' comparative advantage in industries with high spillovers, that is, if the opportunity cost of the high-spillover generating goods is lower than the international price of that good in case the country were able to reap the externalities (see e.g. Harrison and Rodriguez-Clare, 2010). The reason why latent comparative advantages arise is that the pattern of specialisation is determined by current cost structures and not the cost structure that takes into account the benefits from the externalities in the advanced industry. Turning a latent comparative advantage into a 'manifest' comparative advantage builds a case for a targeted industrial policy, in the tradition of the infant industry argument[3]. Such externalities are also at the core of cluster policies, a currently very popular variant of industrial policy in Europe.

The classical infant industry argument demands subsidies (or tariff protection) to be temporary and any industry must finally survive international competition on its own. The requirement that an industry is finally viable without government support and generates exports is known as the Mill test (Harrison and Rodriguez-Clare, 2010). A related but stricter

[2] Marshallian externalities may arise from the availability of a skilled labour pool, availability of specialised inputs or availability of the appropriate infrastructure (Marshall, 1920; Fujita and Thisse, 2002). In the presence of intra-industry spillovers the productivity of an industry increases with its size and this will result in the agglomeration of economic activity in individual industries in specific cities, regions or countries (Harrison and Rodriguez-Clare, 2010).

[3] It should be noted that there is a series of difficulties associated with such industrial policy interventions. First of all, it is not easy to evaluate the extent of such spillover, which leads to the difficulty of 'picking winners', i.e. the eligible industries, which is a ubiquitous problem for industrial policy (see for example Hausmann and Rodrik, 2006). Moreover, the size of spillovers is not necessarily intrinsic to an industry but depends on the way production is organised in any particular industry (Rodriguez-Clare, 2007). Therefore the scope for externalities in any particular industry may vary considerably across countries depending on a number of factors such as endowments or technological capacities.

test is the Bastable test which requires that the cumulative net benefits of industrial policy exceed the cumulative cost of the intervention (Melitz, 2005; Harrison and Rodriguez-Clare, 2010). We cannot empirically test the Mill-Bastable criterion because we have no information on which firms or industries received subsidies and when the subsidies where terminated. However, a positive relationship between aid to the manufacturing sector and manufacturing exports would point in this direction as European state aid rules do not allow for continued government support for individual firms.

The existence of externalities may not be limited to specific-sectors. If externalities also spread across industries then the expansion of industries that are the source of such spill-overs lead to higher wages and welfare in the whole economy. This is for example the case in early learning-by-doing models (Succar, 1987; Young, 1991). If particular industries that generate high inter-industry spillovers can be identified, supporting such industries with subsidies may again be welfare enhancing. In this case, sector-specific targeting is economically rationale even though the country has no latent comparative advantage in that industry. In other words, industrial policy goes against comparative advantage because the gains of additional externalities outweigh the costs of specialising in industries that lack comparative advantages.

Another case in favour of state aid with the explicit objective of increasing a country's export performance is brought forward by strategic trade theory. The target of strategic trade policy[4] is to capture large export market shares in oligopolistic (imperfectly competitive) industries. Governments can intervene in international competition by offering subsidies, e.g. R&D subsidies, to their domestic producer. If the government can credibly commit itself to such a policy, it can influence the market outcome in an oligopolistic market to the advantage of the domestic producer. This is because from the viewpoint of the firms, the R&D subsidy represents a reduction of costs and will lead to a larger market share. In such a strategic game the optimal R&D subsidy, i.e. the subsidy that maximises domestic rents, puts the domestic producer in a position where it gains a market share identical to that of the leader firms in an asymmetric Stackelberg leader-follower type oligopoly (Brander and Spencer, 1983)[5].

Despite a plethora of reasons that may justify state aid support[6] there is little empirical work on the effects of state aid on exports. A notable exception is a policy note by Aghion, Bou-

4 Strategic trade policy refers specifically to the governments potential to influence the relative positions of rivalling firms in oligopolistic markets by influencing their reaction functions while industries may be considered to be of strategic importance for a wide array of reasons including economic rents but also externalities and non-economic reasons such as national independence.

5 The strategic trade policy has predominantly been modelled as industrial policy in the form of R&D subsidies despite the fact that in international competition for global market shares direct export subsidies would be more efficient. The reason for this is that subsidies contingent on export sales are prohibited by WTO rules (Brander and Spencer, 1983).

6 For a more comprehensive overview of theoretical considerations of industrial policy see Cohen (2011), Warwick (2013) and Harrison and Rodriguez-Clare (2010).

langer and Cohen (2011) in which sector-specific state aid provided by EU Member States is related to the Member States shares in total EU exports. Making use of country-level data for 15 EU Member States for the period 1995-2007 they find positive effects of sector-specific aid on export performance. Moreover, in their empirical model state aid is interacted with a proxy for the development of financial markets (private credit). From the resulting negative coefficient of this interaction term the authors deduct a substitutive relationship between state aid and financial market development, i.e. that state aid is more effective in countries with less developed financial markets.

Our paper is following the contribution of Aghion, Boulanger and Cohen (2011) insofar as we draw on the same data source for state aid data and we are interested in the impact of state aid on exports. However, we make use of data for the EU-27 over the period 1995-2011 instead of limiting the analysis to the EU-15. Also we use (real) value added exports instead of gross exports as the dependent variable since we are interested mainly in the impact of state aid on the domestic value added that is exported (see Johnson and Noguera, 2012). Most importantly, we embed our regression model in a macro-economic export function and therefore include a set of control variables such as the real exchange rate and foreign GDP.

In contrast to Aghion, Boulanger and Cohen (2011) who investigate the effects of sector-specific aid on exports (which in a European context mainly covers rescue and restructuring aid to firms from very diverse sectors such as banks, airlines or shipyards), we are interested in the effects of 'manufacturing aid' which includes sector-specific aid to the manufacturing sector and a number of 'horizontal' aid categories which can be assumed to be attributable mainly to the manufacturing sector such as R&D aid[7] or commerce, export and internationalisation aid. Our focus on manufacturing aid stems from the fact that we want to investigate whether state aid support, in the form and to the extent that it is currently provided by EU Member States, is conducive to the export performance of the manufacturing sector.

With respect to the focus on the manufacturing sector our paper is also related to Gual and Jódar (2006). They argue that the majority of horizontal aid provided by Member States is de facto sectoral aid to the manufacturing sector and analyse the effects of manufacturing aid (as a share of value added) on total factor productivity (TFP) growth for a sample of eleven Member States over the period 1995-2003. They incorporate state aid into an endogenous growth model as one of the potential factors that affect a country's steady-state equilibrium (in addition to the frontier growth rate and a catch-up term). Controlling for potential endogeneity of state aid by using political indicators as instruments they find a positive effect of aid to the manufacturing sector on TFP growth. They conclude that their re-

7 In the EU about 80% of total business R&D is undertaken by manufacturing firms (see e.g. Stöllinger et al., forthcoming)

sults challenge the conventional wisdom that the efficiency justification for sector-specific state aid is weak.

Midelfart-Knarvik and Overman (2002) investigate the effects of the EU's Structural Funds on the location decision of firms. While their focus is on the provision of EU aid funds, they also include selected types of national state aid (e.g. R&D aid or aid to small and medium enterprises) in their regression but do not find any significant effects of Member States' state aid programmes on the relocation of firms.

The effect of state aid on firm performance has also been investigated at the firm level. For example, using a large sample of Belgian firms Buts and Jegers (2013) find that firms receiving state aid experience gains in their market shares with a time lag of two years. There are also a number of papers that estimate the impact of specific aid programmes on firm performance. The careful study by Criscuolo et al. (2012) uses exogenous changes in the eligibility of UK regions for a regional aid programme as an identification strategy which allows them to test for causal effects of this support scheme. Their estimates point towards positive treatment effect of the regional aid programme on employment, investment and net entry of firms though they do not find effects on TFP. Moreover, the positive effects of the programme are confined to smaller firms whereas for larger firms no significant effects are found. Badinger and Url (2012) assess the impact of export credit guarantees issued by the Austrian export credit agency on the export performance of a cross section of Austrian firms. They find economically large and statistically significant effects on the export performance of firms receiving export credit guarantees.

Our interest, however, is broader in scope as we are interested in the relationship between state aid to the manufacturing sector and export performance (in value added terms) at the country-level. As is generally the case, results found at the firm level do not necessarily translate to the industry or country level. Potentially, positive effects on the performance of firms receiving state aid could be counteracted by negative impacts on other firms. Hence, neither productivity nor the export performance is necessarily improved even if there are firm level effects. The next section discusses the data used to shed light on the state aid-export nexus in the manufacturing sector.

3. Data

3.1 Data description and general features of state aid by Member States

We draw our data from a variety of international data sources. The most important of these data sources are the State Aid Scoreboard of the European Commission[8] and the World Input-Output Database (WIOD)[9].

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[8] See: http://ec.europa.eu/competition/state_aid/studies_reports/studies_reports.html

One of the unique institutional features of the European Union is that the sovereign governments of all EU Member States agreed to have their state aid activities restricted and monitored by the European Commission. All state aid measures provided by EU Member States have to comply with EU competition law which also includes detailed rules on state aid. In particular, governments are not allowed to grant aid that distorts or threatens to distort competition and affect trade between Member States[10]. The state aid rules also imply that, in principle, all aid measures of Member States have to be notified ex ante to the Commission. Importantly, the Commission is also empowered to prohibit planned aid measures or programmes of Member States. The control of state aid of sovereign governments is obviously a delicate issue and the European Commission has shown a large degree of pragmatism in this respect (Doleys, 2012).

This general prohibition of trade distorting aid is qualified by a number of exceptions and additional considerations. For example, aid may be considered compatible with the Single Market if it is related to a project of common European interest. Moreover, not all state aid is necessarily trade distorting. Indeed, in the case of most aid programmes that aim at ‘horizontal’ objectives (‘horizontal aid’) the European Commission assumes a priori that these are not trade distorting, if they comply with the conditions laid out in the Commission’s General Block Exemption regulation[11], which is why such aid programmes are exempted from the ex-ante notification obligation. Horizontal aid includes for example R&D aid or aid for training measures. The Commission is more sceptical about sector-specific aid which is more and more limited to rescue and restructuring aid measures. The European Commission’s preference for horizontal state aid is founded in the belief that horizontal aid is less distortive to competition than sectoral aid (Friederiszick, Röller and Verouden, 2006) and that it contributes to the Commission’s own market-correcting or redistributive policy goals and is therefore linked to an objective of ‘common interest’ (Blauberger, 2008). This preference for horizontal aid on the side of the Commission has a big impact on the type of state aid provided by Member States – or at least the way it is notified. The overwhelming majority of EU state aid is currently provided in the form of horizontal aid with 90% of state aid being notified under some block exemption scheme (Szczepanski, 2013).

The notification requirement for Member States’ state aid implies that there is systematic information on Member States state aid activities. The information on actual *aid amount* is published at an annual level and according to ‘objective’ in the case of horizontal aid and according to broad sectors in the case of sector-specific aid.

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9 See: http://www.wiod.org/

10 Article 107 of the Treaty on the Functioning of the European Union (TFEU).

11 Such conditions include for example limits to the maximum amount of aid which is typically defined as a percentage of the eligible project costs.

We make use of the state aid data for the 27 EU Member States for the period 1995-2011 published in the EU State Aid Scoreboard (expressed in real euro with the base year of 2010). When using the data a couple of important aspects concerning the scope, definition and compilation of state aid have to be taken into account. First of all it is essential that the data from the State Aid Scoreboard contains exclusively aid that is provided and notified by Member States. Aid that is provided out of the EU budget through the EU Cohesion and Structural Funds is not included. Second, only 'specific' measures by governments are considered as state aid. General measures for the economy and in particular general tax regulations do not fulfil this criterion of specificity. For example, a tax exemption for a particular company from the corporate tax constitutes state aid. A general reduction of the corporate tax rate or even the abolition of the corporate tax in a country would not constitute a state aid measure. Third, since state aid comes in different forms and shapes, including outright grants, tax breaks, state guarantees at preferential fees, subsidised loans etc., the State Aid Scoreboard reports aid figures in terms of the 'aid element' contained in the respective aid measure. For example, the aid element of a grant is 100%, i.e. the full amount of the grant while for an interest-free loan the aid element would be lower than the nominal loan amount, equal to the interest payments that would accrue for a loan provided at market interest rates. Fourth, while certain horizontal aid programmes are exempted from the ex-ante notification requirement, the actual aid amounts paid out of these programmes still need to be notified to the Commission (ex post information sheets) and are hence included in the aid figures of the State Aid Scoreboard. In contrast, so-called 'de-minimis' aid, that is, aid measures not exceeding EUR 200,000, is not considered to threaten competition and therefore does not constitute state aid. Hence, de-minimis aid is not included in the state aid figures (see European Commission, 2008a). Fifth, in 2008 the European Commission temporarily introduced additional state aid rules as a reaction to the economic crisis. For the real economy, some state aid rules were relaxed under the so-called 'Temporary Framework'. Aid granted under the Temporary Framework which was terminated by the end of 2011 is accounted for separately in the State Aid Scoreboard (see for example European Commission, 2012b). Unfortunately, for the crisis-related aid to the real economy no break-up by sector or objectives is available which is why we do not include the state aid provided under the Temporary Framework in our econometric work[12].

The combined state aid to industry and services of all EU Member States dropped from about EUR 70 billion to EUR 58 billion (including aid provided under the Temporary Framework) in 2011. This declined trend in state aid is more pronounced when state aid relative to GDP is considered, which went down from 0.74% of GDP in 1995 to 0.46% in 2011. This indicates that state aid in the EU is at historic low levels. For comparison, during the 1980s state aid to industry and services provided by EU Member States amounted to

12 In addition the Temporary Framework specific state aid rules for the financial sector were established. Aid granted to the financial sector was much more important than aid granted to the real economy amounting to more than EUR 5 trillion or 40% of EU GDP (Szczepanski, 2013).

approximately 2% of EU GDP (European Commission, 2011). This marked drop in the amounts of state aid is partly owed to frustrations with disappointing outcomes of active state aid policy but was also induced by a strengthening of state aid rules by the Commission. In general, industrial policy in the form of state aid came increasingly out of fashion and the policy focus shifted towards market-oriented measures such as changes in product and labour market regulations and privatisations which Wade (2012) has described as a weakening of the 'interventionist priors'.

Despite the fact that state aid levels are at a historic low in the EU it should be stressed that by international standards Member States still appear to be active providers of aid. Judged by WTO notifications of subsidies EU Members States' state aid amounts exceed that of the US by a factor of six (Buigues and Sekkat, 2011).

3.2 Overview of state aid to the manufacturing sector

Having examined the general characteristics of European state aid we can turn to our variable of interest, i.e. state aid to the manufacturing sector which is a subset of total state aid.

Unfortunately, the European Commission does no longer publish data on general aid to the manufacturing sector. It had done so until 2006 although accompanied by the note that *'data on aid to manufacturing may be overestimated'*[13]. The reason for this is that the Commission used to include various types of horizontal aid into the calculation of aid to the manufacturing because most horizontal aid can be assumed to target the manufacturing sector (see also Gual and Jódar, 2006). So the allocation of most horizontal aid measures is based on an assumption and not on actual data since horizontal state aid data by sector is not available.

Regional aid, which is quantitatively important, is sometimes considered an aid category by itself (see Szczepanski, 2013). However, in its current State Aid Scoreboard publications the Commission includes regional aid in the horizontal aid measures[14]. This seems justified as investment promotion schemes (often designed to attract foreign firms, i.e. 'FDI promotion schemes') are primarily targeted at the manufacturing sector. We therefore include regional aid in our definition of manufacturing aid. In addition to the sector-specific aid to the manufacturing sector our measure of manufacturing aid includes the following horizontal aid categories: commercialisation, export and internationalisation aid ('internationalisation aid'); R&D aid; risk capital aid; aid to small and medium enterprises ('SME aid'); environmental aid; regional aid and employment aid and training aid. By adding sector-specific and horizontal aid together we align ourselves with Midelfart-Knarvik and Overman (2002)

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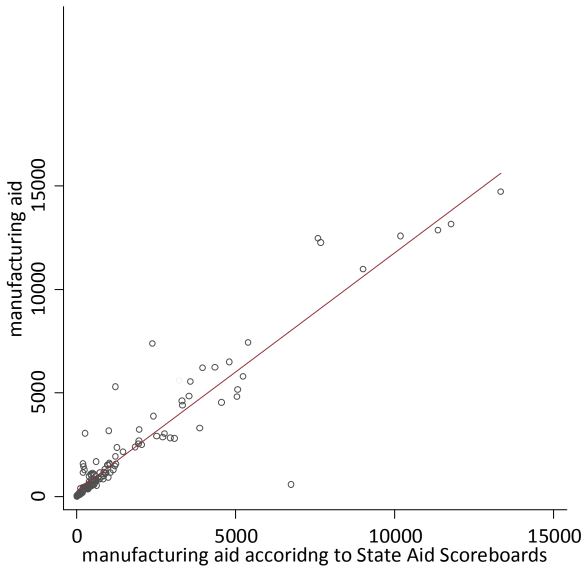
[13] See for example European Commission (2008b)

[14] See http://ec.europa.eu/competition/state_aid/studies_reports/expenditure.html#3.

who point out that after all the effects of sector-specific and horizontal aid may not be that different and that in principle both can be distortionary.

Figure 1

Comparison of the manufacturing aid by EU Member States, 2000-2006



Source: European Commission State Aid Scoreboard, various editions of European State Aid Scoreboard Report, authors' own calculations.

Our definition of manufacturing aid leads to very similar values as those reported in State Aid Scoreboard between 2000 and 2006. This is shown in Figure 1 which by plotting the manufacturing aid of Member States resulting from our definition – shown on the vertical axis – against those reported in various State Aid Scoreboards – shown on the horizontal axis – between 2000 and 2006. The fact that most observations are on the or close to the 45-degree line indicates that our data for manufacturing aid coincides with that used by the Commission until 2006.

Table 1 shows the average annual amounts of state aid to the manufacturing sector disbursed by Member States over the sample period. For the EU-27, aid to the manufacturing sector accounts for roughly three quarters of total aid to industry and services. The importance of aid to the manufacturing sector varies quite a lot across EU Member States but with the exception of Portugal and the Czech Republic exceeds 50% of total aid to industry and services. The manufacturing sector receives more than 90% of total state aid to industry and services in a number of Member States including Austria, Belgium, Denmark, Finland, Greece, Italy, Luxembourg, Latvia, Malta, the Netherlands, Slovakia and Sweden.

In absolute terms, unsurprisingly, the larger EU Member States also emerge as the major providers of state aid to the manufacturing sector. With an annual average of EUR 13.9 billion Germany is by far the largest provider of manufacturing aid, followed by France, Italy and Spain. The UK spends relatively little amounts of manufacturing aid (EUR 2.6 billion annually) given the size of the economy.

Table 1

State aid to the manufacturing sector by EU Member States, averages 1995-2011

	aid to the manufacturing sector		
	in EUR mn	**in % of total state aid**	**in % of EU-wide manufacturing aid**
AUT	986	92.7	2.1
BEL	1,131	97.0	2.4
BGR	43	77.4	0.1
CYP	101	57.9	0.2
CZE	754	47.7	1.6
DEU	13,878	73.6	29.9
DNK	1,341	95.5	2.9
ESP	3,396	62.0	7.3
EST	10	72.0	0.0
FIN	618	96.4	1.3
FRA	6,457	62.2	13.9
GBR	2,646	82.4	5.7
GRC	973	98.2	2.1
HUN	915	79.6	2.0
IRL	521	81.3	1.1
ITA	6,382	90.5	13.8
LTU	58	87.8	0.1
LUX	64	91.4	0.1
LVA	72	99.3	0.2
MLT	137	96.3	0.3
NLD	1,107	93.7	2.4
POL	1,454	60.4	3.1
PRT	744	33.4	1.6
ROU	569	58.5	1.2
SVK	235	93.0	0.5
SVN	174	87.5	0.4
SWE	1,646	90.8	3.5
EU-27	46,409	73.4	100.0

Note: Figures exclude crisis-related aid. Total state aid is state aid to industry and services. Amounts refer to the aid element (or gross grant equivalent in the case of guarantees and loans) contained in the state aid measure. All data refer to real aid with base year of 2010.

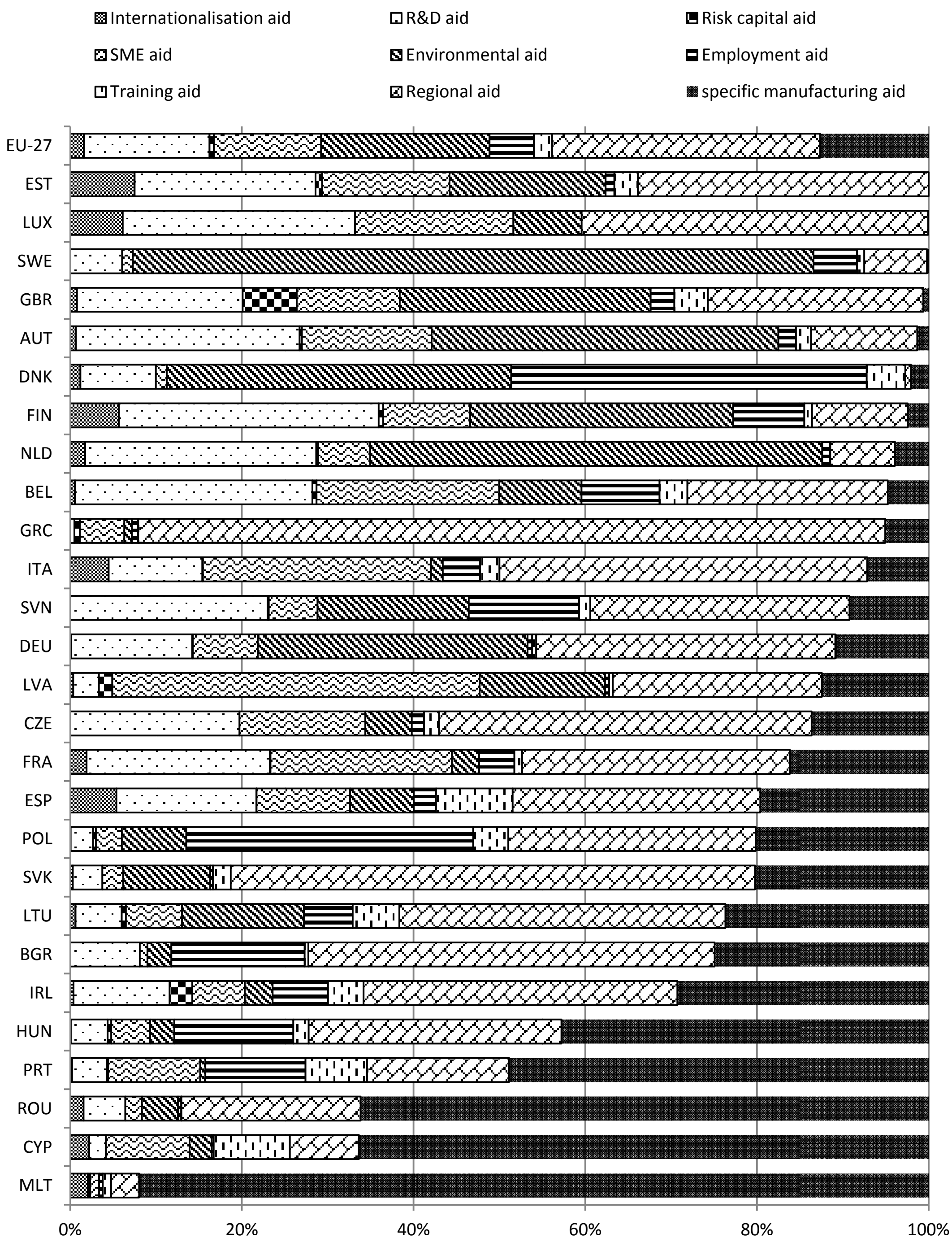
Source: European Commission State Aid Scoreboard, authors' own calculations.

Figure 2 provides the split-up of our measure of manufacturing aid into the various aid categories.

When considering the state aid provided by all 27 Member States (EU-27) over the period 1995-2011, regional aid turns out to the most important single aid category accounting for almost a third of manufacturing aid. The second most important aid category is environmental aid (20%) followed by R&D aid (15%),SME aid and sector-specific aid to manufacturing each accounting for about 13% of manufacturing aid.

Figure 2

Broad manufacturing aid by aid category by Member State, averages 1995-2011



Note: Figures exclude crisis-related aid. Amounts refer to the aid element (or gross grant equivalent in the case of guarantees and loans) contained in the state aid measure. . All data refer to real aid with base year of 2010.

Source: European Commission State Aid Scoreboard, authors' own calculations.

However, the composition of manufacturing aid varies considerably across Member States. For example, in general R&D aid is of lesser importance in the Central and Eastern European Member States (with the exception of the Czech Republic). Country-specific preferences for certain state aid categories are also easily discernible. For example, Sweden spends almost 80% of its aid to the manufacturing sector on environmental aid whereas in Greece 87% of aid to the manufacturing sector consists of regional aid. Internationalisation aid and risk capital aid are only of minor importance in basically all Member States.

The relative importance of sector-specific aid ranges from 92% of the aid to the manufacturing sector (Malta) to effectively 0%. In only 8 out of the 27 Member States, sector-specific aid accounts for more than 20% of broad aid to manufacturing. The relatively low and declining share of sector-specific aid is to a certain extent due to the Commission's preference for horizontal aid. Therefore it may be assumed that a good part of the aid measures notified as horizontal aid is de facto sector-specific aid (see also Gual and Jódar, 2006). This is why we operate with a composite measure of manufacturing aid that is far broader than sector-specific aid to the manufacturing sector.

3.3 Further sources of data

Apart from the European Commission's State Aid Scoreboard this paper also makes intensive use of the World Input-Output Database (WIOD), in particular the World Input-Output Table (WIOT). The WIOT contains information on 40 countries, including the 27 Member States, and allows calculating value added export following the concept of Johnson and Noguera (2012). Intuitively, the value added exports of a country *r* is the value added generated in that country but absorbed in another country. We calculate the value added exports of each EU Member State using the external demand vectors as starting points. By using the information of the (direct and indirect) global sourcing patterns for intermediates provided in the Leontief Inverse these final demand vectors are assigned to each supplying country to the appropriate extent. Applying a country's (sector-specific) value added coefficients to this external demand assigned to it, yields the value added that is generated in that country but consumed abroad.

In matrix terminology bilateral value added exports of country *r* shipped to country s can be expressed as $VAX^{rs} = \boldsymbol{v}^r \boldsymbol{L} \boldsymbol{f}^s$ where $\boldsymbol{v}^r$ denotes a 1x1435 vector including value added coefficients of country *r* and zeros otherwise, $\boldsymbol{L}$ is the global Leontief inverse and $\boldsymbol{f}^s$ denotes a 1435x1 column vector with final demand of country *s* in its own country and other countries including country *r.* The aggregate value added exports of country *r,* noted VAX^{r*}, are obtained by adding up the bilateral value added exports across trading partners, i.e. $VAX^{r*} = \sum_{s \neq r}^{C} \boldsymbol{v}^r \boldsymbol{L} \boldsymbol{f}^s$.

The value added exports obtained from the WIOT are in nominal US-Dollars. We first translate these value added exports into national currency using market exchange rates obtained from Eurostat. Then we apply price deflators for value added from the AMECO database to get the real values in national currency. Deflators from the AMECO database are very similar to the deflators in the WIOD (available until 2009 only). Hence, in the cases where AMECO deflators are missing, we use the WIOD deflators. In all cases we rebase the price deflators to the base year 2010. The real value added exports in national currency are then transformed into euro using the respective exchange rate to the euro of the year 2010.

We use the value added exports as our preferred measure for external competitiveness but we will also use gross exports as a robustness check. In addition, for both the value added exports and the gross exports we perform the analysis for total exports as well as extra-EU exports only. The latter is done because of the ambiguity about the character of intra-EU exports which in a European Single Market may not really constitute exports anymore.

For our empirical model we also require a series of additional variables. The main ones are the real effective exchange rates of each Member States which is the labour cost based multilateral exchange rate vis-à-vis 36 partner countries. Data is obtained from Eurostat. We also need a measure of foreign gross domestic product (*GDP**) for all countries in the WIOD database plus the rest of the world. For this, we turn to the IMF World Economic Outlook database but transform the values (which are originally expressed in USD) into euros. The measure of foreign GDP we actually use in the regression analysis is the weighted GDP of the EU Member States' trading partners. The shares of the respective trading partner in each Member States' total exports are used as weights. Employing these export shares as weights and summing up over all trading partners, *n*, yields the measure of foreign GDP which is different for each Member State and year depending on the relative importance of trading partners. Formally, the foreign gross domestic product, GDP^*, relevant for Member State *i* is calculated as $GDP_i^* = \sum_n \left(GDP^n \cdot \frac{X^{i,n}}{\sum_n X^{i,n}} \right)$, where $X^{i,n}$ represents exports of Member State *i* to country *n*.

A further variable we include is monthly labour costs per person in the industrial sector excluding construction. The data comes from Eurostat and serves as proxy for the wage level and therefore also for the productivity level in the sector. The compilation of the variable required merging data recorded according to NACE Rev. 1 and NACE Rev. 2 industry classifications. As a general rule, we switch from NACE Rev. 1 to NACE Rev. 2 in 2005. However, in order to minimise the breaks we deviate from the rule for some countries and make the switch later in order to avoid breaks and have a smooth time series.

Moreover, we use the point estimates for government effectiveness provided in the World Bank's Worldwide Governance Indicator (WDI) Database. Government effectiveness reflects the perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. The values for government effectiveness originally range from -2.5 to + 2.5 where higher values indicate higher government effectiveness. Since we will work with a logged version of the variable we transform it to range from 0 to 5.

In addition to these control variables, we also require a series of instrumental variables. There are two sets of instruments. A first set of instruments are government expenditures for environmental protection, social protection and health. The assumption here is that, governments which are prepared to spend public money on environmental protection for example are also more prone to paying out subsidies to firms. The instrumental variables related to government expenditures, all expressed in euro, are obtained from Eurostat. Secondly, we make use of the World Bank's Database of Political Institutions 2012 (DPI) to obtain instruments reflecting Member States' political systems. More precisely, we include the margin of majority, which is the fraction of seats held by the government divided by the total number of seats in the parliament; the fragmentation of the government, which is the probability that any two deputies picked at random from all government parties' deputies belong to the same party; and whether executive elections took place in the respective year (see Keefer, 2012) in the list of instruments. The latter is a dummy variable taking the value 1 if executive elections took place that year and 0 otherwise.

4. Empirical Strategy

4.1 Econometric Model

The starting point for our empirical model is a simple export function as found in standard macroeconomic textbooks (e.g. Blanchard, 2008) though we keep the focus on the manufacturing sector:

(1) $$X = X(FX, GDP^{*})$$

where X denotes exports of the manufacturing sector (in euro), *FX* is the real exchange rate, expressed as an index and GDP^{*} is foreign gross domestic product (in euro). As pointed out above, value added exports serve as our main export measure but we will also employ gross exports as a robustness check. In the standard macroeconomic model, the impact of the real exchange rate on exports is negative. The reason for this negative relationship is that a rise of the relative price of domestic goods (i.e. a rise in the index of the real exchange rate) makes domestic exports relatively more expensive relative to foreign goods. The foreign level of GDP is relevant for the external demand for domestic goods. A part of the additional demand that is induced by the increase in foreign GDP will be spent on imports from the domestic economy. Therefore a country's exports should rise with foreign GDP.

We enrich this basic export function for the manufacturing sector by assuming that the level of exports also depends on the wage level denoted by *WAGE* which also reflects the level of productivity in a country. Moreover, we assume that there is a role for the government to influence export performance. More precisely, we hypothesise that by providing state aid to the manufacturing sector, governments can impact exports and therefore include the amount of state aid to the manufacturing sector (*AID*) into the export function. The effect of state aid on manufacturing exports is of course our main interest. Furthermore, we also allow for the possibility that the quality of the government, i.e. government effectiveness (*GOVEFF*), may be conducive to manufacturing value added exports. Hence, the export function has the following general form:

(2) $$\mathrm{X} = \mathrm{X}(\mathrm{FX}, \mathrm{GDP}^{*}, \mathrm{WAGE}, \mathrm{AID}, \mathrm{GOVEFF})$$

This export function serves as the basis for our empirical specifications which we estimate in logarithmic form. The main reason for the logarithmic transformation is that the original export data (real value added exports) of the EU Member States is highly skewed. When taking logs, the distribution of our dependent variable gets closer to a normal distribution.

Our data consists of a panel with 27 countries observed over a period of 17 years. The panel is slightly unbalanced because for the Central and Eastern European Member States which joined the EU in 2004 state aid data is only available from 2000 onwards and for Bulgaria and Romania from 2002 onwards leaving us with 394 observations[15]. This also means that we include observations for countries in years where they have not been EU members yet. For this reason we also include a dummy variable for EU-membership (*MS*) that takes the value 1 for country-year combinations where the country was an EU member and 0 otherwise. With *i* indicating countries and *t* indicating years and taking into account that we work with value added exports as the preferred dependent variable, we get the following regression model:

(3) $$\mathrm{vax}_{\mathrm{i,t}} = \alpha + \beta_1 \cdot \mathrm{aid}_{\mathrm{i,t}} + \gamma_1 \cdot \mathrm{fx}_{\mathrm{i,t}} + \gamma_2 \cdot \mathrm{gdp}^{*}_{\mathrm{i,t}} + \gamma_3 \cdot \mathrm{wage}_{\mathrm{i,t}} + \gamma_4 \cdot \mathrm{MS}_{\mathrm{i,t}} + \mu_{\mathrm{i}} + \delta_{\mathrm{t}} + \varepsilon_{\mathrm{i,t}}.$$

where all variables enter the equation in log-form as indicated by the use of minuscules. Note that the specification also includes a full set of country-fixed effects, μ_i, and time-fixed effects denoted by δ_t. The error term is denoted by $\varepsilon_{i,t}$.

The coefficient of main interest is β_1 which we expect to be positive because state aid is at least partly provided with the objective of increasing exports. This objective may be implicit, but in an open economy, any effective policy support for an industry that is granted on effi-

[15] 1995 state aid data for Sweden is also not available.

ciency grounds is likely to also increase exports. This leads to the first hypothesis that we want to test:

Hypothesis 1: The provision of state aid to the manufacturing sector stimulates a country's value added exports.

With regard to the remaining variables standard macroeconomic models, as mentioned above, would predict a negative impact of the real exchange rate, i.e. $\gamma_1 < 0$, and a positive impact of foreign GDP, i.e. $\gamma_2 > 0$, on export performance. Note, that since our export measure focuses on domestic value added embodied in exports there is no need to control for imported inputs. Furthermore, we expect that exports increase with the level of productivity and hence a positive coefficient for the labour cost and hence $\gamma_3 > 0$.

A major concern in specification (3) is the potential endogeneity of state aid to the manufacturing sector. This stems from the fact that governments may be more tempted to provide state aid to manufacturing industries in countries where these are important for exports. In general, the larger the manufacturing sector is, the larger is the probability that the government is captured by vested interests of manufacturing firms[16]. We attempt to handle the issue of endogeneity with a two-stage instrumental variable (IV) approach where manufacturing state aid is instrumented by a number of government related indicators that can be assumed to have to impact on manufacturing exports. The list of instruments include government expenditure on environmental protection (*envprot*), on social protection (*socprot*) and on health (*health*) as well as political indicators including the government's margin of majority (*majority*), the fragmentation of the government (*govfrac*) and a dummy variable indicating whether executive legislation have taken place in any particular year (*exelec*). The two indicators for the political system, the margin of majority and government fragmentation, do not enter in logged form because they are already expressed in percentages of votes in parliament and a probability respectively. In the first stage of the IV regression the following equation is estimated:

$$\text{(4)} \quad \mathrm{aid}_{i,t} = \omega_0 + \omega_1 \cdot \mathrm{envprot}_{i,t} + \omega_2 \cdot \mathrm{socprot}_{i,t} + \omega_3 \cdot \mathrm{health}_{i,t} + \omega_4 \cdot \mathrm{majority}_{i,t} + \omega_5 \cdot \mathrm{govfrac}_{i,t} + \omega_6 \cdot \mathrm{exelec}_{i,t} + \omega_7 \cdot \mathrm{fx}_{i,t} + \omega_8 \cdot \mathrm{gdp}^*_{i,t} + \omega_9 \cdot \mathrm{wage}_{i,t} + \omega_{10} \cdot \mathrm{MS}_{i,t} + \mu_i + \delta_t + \nu_{i,t}$$

Another possibility that we want to take into account is that governments may provide too much state aid to firms. As the amounts of state aid grows, the marginal impact of the aid can be expected to decline and finally turn negative as further subsidies would just be the result of successful lobbying for subsidies by vested interests. This would reflect the often cited 'government failure' in the context of industrial policy which implies a waste of public money.

[16] There is of course also the temptation of governments to provide support for ailing industries which would suggest a negative causal link between export performance and state aid.

We capture the potential non-linearity in the relationship between state aid and exports by including a quadratic state aid term into the regression:

(5) $$\mathrm{vax}_{i,t} = \alpha + \beta_1 \cdot \mathrm{aid}_{i,t} + \beta_2 \cdot \mathrm{aid}_{i,t}^2 + \gamma_1 \cdot \mathrm{fx}_{i,t} + \gamma_2 \cdot \mathrm{gdp}_{i,t}^* + \gamma_3 \cdot \mathrm{wage}_{i,t} + \gamma_4 \cdot \mathrm{MS}_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t}.$$

In specification (5) we continue to expect that the coefficient of manufacturing aid, β_1, is positive and we expect the coefficient of the quadratic term, β_2, to be negative. In order to avoid the problem of multicollinearity we estimate equation (2) using centred values of the linear and the squared state aid variables (*aid and aid*^{2}). With this specification of the model we can test a second hypothesis:

Hypothesis 2: The positive effect of manufacturing aid on exports diminishes with increasing amounts of aid and may eventually turn negative.

In the presence of a quadratic term, the marginal effect of state aid on exports is given by:

$$\frac{\partial vax}{\partial aid} = \beta_1 + 2 \cdot \beta_2$$

We investigate a further non-linearity in order to test a third hypothesis according to which state aid has a stronger impact on export performance in countries with more effective government structures. We capture this non-linearity by interacting state aid to the manufacturing sector with the government effectiveness indicator resulting in the following specification:

(6) $$\mathrm{vax}_{i,t} = \alpha + \beta_1 \cdot \mathrm{aid}_{i,t} + \gamma_1 \cdot \mathrm{fx}_{i,t} + \gamma_2 \cdot \mathrm{gdp}_{i,t}^* + \gamma_3 \cdot \mathrm{wage}_{i,t} + \gamma_4 \cdot \mathrm{goveff}_{i,t} + \phi \cdot \left(\mathrm{aid}_{i,t} \cdot \mathrm{goveff}_{i,t}\right) + \gamma_5 \cdot \mathrm{MS}_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t}$$

where $aid_{i,t} \cdot goveff_{i,t}$ is the interaction term formed by (the log of) manufacturing aid and (the log of) government effectiveness. Again, in order to avoid the problem of multicollinearity we estimate this non-linear model using centred values of the variables forming the interaction term, i.e. state aid and government effectiveness. We expect the coefficient of the interaction term, ϕ, to be positive. The implied hypothesis is:

Hypothesis 3: The marginal effect of state aid to the manufacturing sector on export performance is higher in countries with more effective governments.

This seems a plausible hypothesis given the great importance attached to 'government failures' in the context of state aid.
The marginal effect of state aid in specification (5) is country-specific and can be calculated as:

$$\frac{\partial vax}{\partial aid} = \beta_1 + \phi \cdot goveff_{i,t}$$

For sake of completeness we will also estimate a variant of the model in equation (6) which includes both quadratic terms and the interaction.

4.2 Time series considerations

With a maximum of 17 years of observations our panel data is relatively short. Nevertheless, in case our variables have a unit root we still have the problem that our regression results may be spurious (see Granger and Newbold, 1974). Therefore we perform standard panel unit root tests opting for the methods suggested by Im-Pesaran-Shin (2003) and the Fisher-type tests (see Madala and Wu, 1999) of which we report the inverse chi-squared statistics. After inspecting the time series graphs of our variables and following the strategy for testing unit root recommended by Elder and Kennedy (2001) we do not include a time trend in the unit root tests. Taking the example of our dependent variable, the value added exports, we observe that the variable is growing but that the first differences do not which suggests that the unit root tests should be performed without a time trend. In addition we perform a Dickey-Fuller type test by regressing the first differences of the respective variable on the first lag of the variable and a time trend taking into account the panel structure of our data:

$$\Delta vax_{i,t} = \kappa \cdot vax_{i,t-1} + \theta \cdot t_t + \mu_i + \varepsilon_{i,t}$$

The Δ indicates first differences so that $\Delta vax_{i,t} = vax_{i,t} - vax_{i,t-1}$ and t is a time trend. Rejection of the t-test that that $\kappa = 0$ points towards a stationary behaviour of the *vax* series (Elder and Kennedy, 2001). In our case we can easily rejected this t-test. This indicative result is confirmed by formal panel unit root tests which we run without a time trend. The results of the IPS and the Fisher-type panel unit root tests are summarised in Table 2. Both tests have as the null-hypothesis that all panels contain a unit root against the alternative that some panels are stationary. For the IPS test we let the lag structure be determined by the Akaike-information-criterion (AIC), for the Fisher-type tests we include one-period lag. For all our variables the two tests are consistent in their proposed results. It seems that two of our variables, the real exchange rate *(fx)* and government effectiveness *(goveff)*, have a unit root.

Table 2

Panel unit root tests

	vax	aid	fx	gdp*	wages	goveff
Im-Pesaran-Shin test (IPS)						
$W_{t\text{-bar}}$ statistic	-1.8025**	-1.7357**	0.9421	-6.5067***	-7.0297***	0.278
p-value	0.0357	0.0413	0.8269	0.0000	0.0000	0.6095
avge lags	1.00	1.44	0.52	1.70	1.52	0.70
Fisher-type test (chi-square)						
Inverse chi-squared	81.1665***	77.5121**	56.5064	149.017***	149.017***	41.4129
p-value	0.0098	0.0197	0.3815	0.0000	0.0000	0.8953
lags	1.00	1.00	1.00	1.00	1.00	1.00

Note: Both tests have as H_0: each time series contains a unit root and H_1: some panels are stationary. Unit root tests include no time trends. The number of lags in the IPS test is determined by AIC with up to 4 lags included in performing the unit root tests.

Since our dependent variable and our main explanatory variable are stationary and our time series dimension is too short to run powerful co-integration tests we tackle the unit root problem simply by running our empirical model in equation (3) excluding the foreign exchange rate. If the coefficient of the manufacturing aid variable does not change significantly we can assume that the results, to which we turn next, are not driven by non-stationarity of the data.

5. Results and Discussion

The results from our fixed effects regressions for the models presented in equations (3), (5) and (6) are summarised in Table 3 along with some additional specifications. Most importantly, these results suggest that the disbursement of manufacturing aid (*aid*) is positively correlated with export performance. In specification (1) which contains the results of the basic regression model in equation (3), the estimated coefficient for manufacturing aid is statistically significant at the 1% level and suggests that an increase in subsidies by 10% is associated, on average, with an increase in real value added exports by 0.57%. Economically, this is a non-negligible effect given that current levels of aid are rather small, typically amounting to less than half a per cent of GDP. This provides support for hypothesis 1 that the subsidies to the manufacturing sector provided by Member States tend to support exports. As predicted by standard macroeconomic theory we also find a statistically significant and economically large negative effect of the real exchange rate (*fx*) – which implies that an appreciation of the real exchange rate hampers exports – as well as a positive effect of foreign GDP (gdp^*) on export performance. For example, a 1% growth of foreign GDP is estimated to boost domestic exports by 0.63%. We also find that the wage level in the industrial sector in Member States – which should reflect the productivity level – is positively associated with exports.

Specifications (2) tests for non-linear effects in the relationship between manufacturing aid and value added exports. More precisely, the quadratic term of manufacturing aid that is included here relates to hypothesis 2. The coefficient of manufacturing aid continues to be statistically significant and is of similar size as in specification (1). As expected the sign of the coefficient of the quadratic aid term is negative. It is, however, far from being statistically significant. Hence, the data does not support the claim in hypothesis 2 that the marginal effect of subsidies declines as aid amounts increase.

Specification (3) repeats the estimation of specification (1) but includes government effectiveness which does not seem to play a direct role for export performance. Specification (4) then adds an interaction term between manufacturing aid and government effectiveness. The idea here is that the effect of government effectiveness affects exports indirectly, insofar as well-functioning governments implement more successful industrial policies and the state aid provided is more conducive to exports. If this is the case, the interaction term should have a positive sign which is what we actually find. However, the coefficient of the interaction term is only significant at the 10% level. We interpret this as mild support for hypothesis 3 that manufacturing aid provided by Member States with high government effectiveness has a stronger effect on value added exports.

Table 3

OLS regression results (fixed effects)

Dependent variable:	**log of value added exports (vax)**					
	(1)	(2)	(3)	(4)	(5)	(6)
aid	0.0574***	0.0561***	0.0574***	0.0671***	0.0613***	0.0650***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.017)	(0.022)
aid^2		-0.0009			-0.0061	
		(0.004)			(0.005)	
fx	-0.9994***	-1.0023***	-0.9992***	-1.0232***	-1.0583***	
	(0.238)	(0.243)	(0.253)	(0.261)	(0.267)	
gdp*	0.6279**	0.6215**	0.6280**	0.6356**	0.5819**	0.6931**
	(0.264)	(0.269)	(0.261)	(0.252)	(0.252)	(0.280)
wage	0.7801***	0.7811***	0.7799***	0.7804***	0.7944***	0.1490
	(0.178)	(0.180)	(0.196)	(0.199)	(0.203)	(0.183)
MS	0.1305**	0.1303**	0.1304**	0.1357**	0.1368**	0.1817**
	(0.054)	(0.054)	(0.051)	(0.052)	(0.052)	(0.068)
aid x goveff				0.0859*	0.1316*	
				(0.048)	(0.068)	
goveff			0.0014	0.0285	0.0054	
			(0.300)	(0.281)	(0.292)	
$goveff^2$					-0.3274	
					(0.796)	
F-test	82.93	76.89	88.25	153.03	139.37	23.14
R^2	0.996	0.996	0.996	0.996	0.996	0.995
R^2-within	0.741	0.741	0.741	0.745	0.747	0.689
R^2-within adj.	0.726	0.726	0.726	0.729	0.730	0.672
obs.	394	394	394	394	394	394

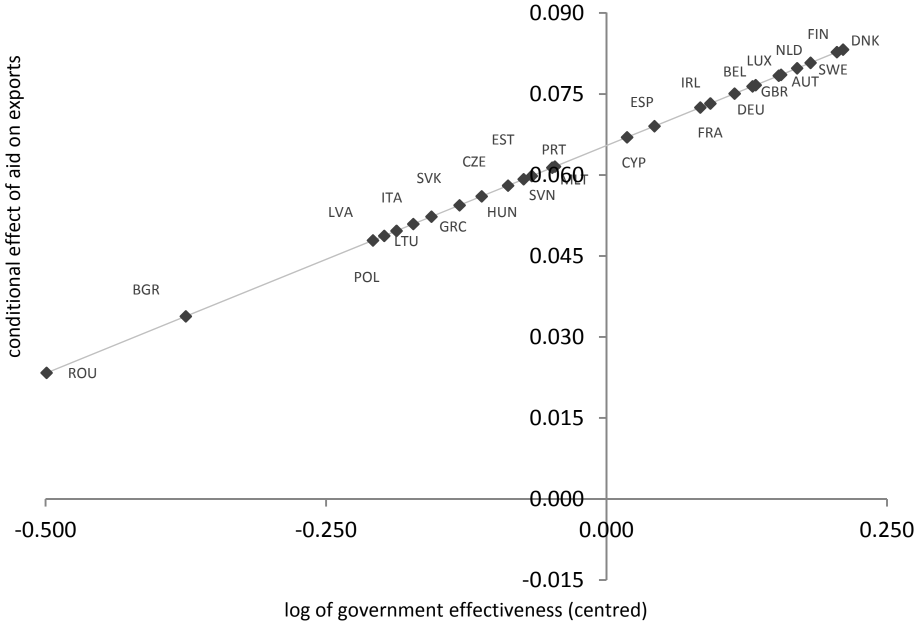
Note: All regressions are in log-log form and include a constant as well as a full set of country-fixed and time-fixed effects. Specifications (2), (4) and (5) are estimated using centred values (with zero mean) of the variables forming the quadratic and interaction terms. ***,** and * indicate statistical significance at the 1%, 5% and 10% level respectively. Standard errors in parenthesis. All regressions estimated with STATA using xtreg except for R^2 which is obtained from estimating using the STATA reg-command with country and time fixed effects included.

This non-linear effect is depicted in Figure 3 for the 27 Member States in our sample based on the average government effectiveness of each country over the period 1995-2011. Since the data on government effectiveness is centred on the mean, some of the values are negative and therefore the resulting effect of aid on exports is below the estimated effect in specification (4) which is 0.67. The largest effects are found for the Nordic countries which have the highest government effectiveness indices. In the case of Denmark, Sweden and Finland as well as the Netherlands, the effect of a 10% increase of manufacturing aid is estimated to increase exports by more than 0.8%. The lowest effects are found for

Romania and Bulgaria. In both cases the conditional effects are still positive but are down to 0.24% and 0.35% respectively.

Figure 3

Conditional effect of manufacturing aid on value added exports of EU Member States, average 1995-2011



Note: Conditional effects take into account the estimated coefficients of manufacturing aid and the estimated coefficient of the interaction term in specification (4). Based on Member States' average government effectiveness for the period 1995-2011.

We can also set the estimated elasticity in relationship to the actual amounts of manufacturing aid provided by EU Member States which summed up to EUR 46.4 billion annually between 1995 and 2011 and average annual value added exports which stood at about EUR 950 billion during the same period. The estimated coefficient of manufacturing aid in specification (4), 0.067, means that that one million more of manufacturing value added exports would 'cost' about EUR 729,000 in additional aid spending to the sector for the average Member States $\left(\frac{46.4\ /\ 100\ (=1\%\ of\ aid\ in\ bn\ EUR)}{950{,}000\ \cdot\ (\frac{0.06707}{100})(=effect\ of\ 1\%\ increase\ in\ aid\ in\ mn\ EUR\ )}\right)$. Put differently, an additional EUR 1 million of aid for the manufacturing sector is expected to increase manufacturing value added exports by 1.37 million. This more than proportional increase in exports can be explained by the capture of positive externalities and oligopolistic rents as a result of the subsidies as pointed out in Section 2.

Importantly, the difference in the effectiveness of aid expressed in absolute values, i.e. the additional amount of exports resulting from an additional 1 million euros in subsidies, varies considerably across Member States. This variation is due to both differences in the ratio of manufacturing aid to value added exports result and differences in the estimated elasticities of manufacturing aid. For example, 1 million of aid to the manufacturing sector results in EUR 1.59 million of extra value added exports in the case of Germany but only EUR 1.12 million in France. Also, for several countries the ‘costs’ in terms of taxpayer money required to pay out the subsidy exceeds the additional exports, e.g. in Italy or Poland where the subsidy-to-value added exports ratios amount to 0.96 and 0.64 respectively. This is very relevant for the formulation of industrial policy in the EU. We would argue that this large variation in the leverage of state aid on export competitiveness can be seen as an argument for a stronger European component in industrial policy and the provision of aid. This is because our results suggest that particularly the countries which would require a strong policy impetus to support the manufacturing sector – such as Portugal or Greece – have particularly low domestic state aid leverage.

Returning to our remaining regression results in Table 3, specification (5) basically repeats the regression in specification (4) but includes the quadratic terms of manufacturing aid and government effectiveness which is the functional form employed by Aghion, Boulanger and Cohen (2011) in their estimations. None of these additional terms turn out to be statistically significant and their inclusion does not change the results. Hence, in contrast to Aghion, Boulanger and Cohen (2011) our result for the effects of manufacturing aid on export performance is not sensitive to the choice of the functional form. Finally, we re-estimate our linear model in specification (1) but omitting the real exchange rate for which we detected a unit root. The result clearly shows that neither the positive relationship between manufacturing aid and exports nor the high explanatory power of the regression is driven by the non-stationarity of the exchange rate variable. The only difference that emerges is that the wage level is not found to be statistically significant in specification (6).

Next we tackle the issue of potential endogeneity of our aid variable resulting from simultaneity between value added exports and manufacturing aid. Rickard (2012), for example, argues that globalisation leads developing countries to shift government expenditures on welfare and social protection to subsidies to the tradable sector and they find a positive correlation between trade openness and subsidies. In order to be in a position to argue that causality runs from manufacturing aid to value added exports we estimate our model with an instrumental variable approach. For this we employ the instrumental variable (IV) estimator for panel data provided by Schaffer (2010). We use again a fixed effect model and we cluster the standard errors by countries thereby assuming that the observations are independent across countries (clusters) but not within countries. As instruments we use on the one hand government expenditure on environmental protection (*envprot*), on social protection (*socprot*) and on health (*health*); and whether the government has a comfortable majority (*majority*), whether the government is a coalition of several parties (*govfrac*) and whether executive elections took place in the respective year (*exelec*) on the other hand. For the first set of instruments it is safe to assume that this type of government expenditure do not improve export performance directly. It is equally reasonable to assume that more activist governments in the environmental and social sphere are also more interventionist when it comes to the provision of subsidies. For the instruments related to the political system there is a priori also no reason why a strong government or a fragmented government should improve or hinder exports. It is likely, however, that a coalition government (i.e. a more fragmented government) is less able to agree on a proper industrial strategy and may hence provide fewer subsidies. For the election variable we can assume that governments are more prone to pay out subsidies when there are elections to be held in the same year. Our choice of instruments is partly similar to that of Gual and Jódar (2006) insofar as we have a set of instruments reflecting the political system albeit the actual instrumental variables are different. We also differ with respect to the second set of instruments where we opt for government expenditures whereas Gual and Jódar (2006) use state aid provided to other sectors as instrumental variables.

After various tests, we finally trimmed down the number of instruments to only four, keeping the three indicators for the political system and the government expenditures on environmental protection but omitting government expenditures for social protection and health because they do not improve the IV-specification[17]. The results of the IV regression, including the first stage regressions, are summarised in

[17] Qualitatively the results from the IV-estimation with the full set of instruments is exactly the same. The estimated coefficient of manufacturing aid is slightly smaller, amounting to 0.92.

Table 4 for the linear model (specification 1) and the model including the interaction term (specification 4).

Starting with the outcome of the second stage regression, we find that the IV-regression confirms the OLS result. The coefficient of manufacturing aid is positive and statistically significant in both specifications and statistically significant at the 10% level in the linear model (specification 1) and the 5% level for the model including the *aid x goveff*-interaction term (specification 4). The lower level of statistical significance compared to the OLS estimates is expected because instrumental variable estimation is less efficient than OLS. Quantitatively, the coefficients are considerably larger amounting to 0.11. The estimated coefficients of the control variables are also in line with the OLS results and all variables remain statistically significant. The major difference in the IV-estimates compared to the OLS regression is that the interaction term between manufacturing aid and government effectiveness in specification (4) is not statistically significant anymore.

Table 4

Instrumental variable estimations (fixed effects)

Dependent variable (2nd stage):	**log of value added exports (vax)**		**log of value added exports (vax)**		
Instrumented variable(s):	**manufacturing aid (aid)**		**aid & aid x goveff**		
Specification	(1)		(4)		
	1st stage	*2nd stage*	*1st stage*	*1st stage*	*2nd stage*
Dependent variable:	(aid)	(vax)	(aid)	(aid x goveff)	(vax)
aid		0.1103*			0.1102**
		(0.064)			(0.053)
fx	-1.1250	-0.9053***	-0.5344	0.1254	-0.9471***
	(1.198)	(0.235)	(0.866)	(0.245)	(0.267)
gdp*	1.8870*	0.5029*	2.0627*	-0.0549	0.5333*
	(1.010)	(0.295)	(1.023)	(0.162)	(0.270)
wage	-0.5155	0.8197***	-0.8910	0.1571	0.8208***
	(0.786)	(0.193)	(0.704)	(0.152)	(0.214)
MS	-0.2533	0.1216**	-0.2795	0.0032	0.1270**
	(0.254)	(0.050)	(0.219)	(0.042)	(0.053)
aid x goveff					0.0901
					(0.082)
goveff			1.9680	-0.7822*	0.0013
			(1.046)	(0.303)	(0.315)
excluded instruments					
majority	-1.5089**		-1.2944**	-0.0355	
govfrac	-0.5900**		-0.4916	0.2515*	
exelec	0.1943		0.1379**	-0.0088	
envprot	0.4065**		0.5345***	0.0106	
envprot x goveff			0.5146	0.6614***	
majority x goveff			1.7361	-3.4956**	
envprot x goveff			2.8076**	-2.3665**	
exelec x goveff			-0.7763	0.3082	
Angrist-Pischke/Kleinbergen-Paap					
Chi-sq. (underidentification)	28.33	10.56	88.03	108.09	15.63
p-value (underidentification):	0.000	0.032	0.000	0.000	0.029
F-test (weak instrument):	6.41	6.41	11.24	13.80	11.01
Hanson's J statistic		2.191			5.676
p-value (validity of instr.):		0.534			0.460
Endogeneity of instruments (C-test):		2.334			0.549
p-value:		0.127			0.760
F-test	9.77	84.57	11.71	21.89	814.06
R^2	0.240		0.320	0.586	
R^2-within		0.724			0.732
R^2-within adj.		0.686			0.692
obs.	389	389	389	389	389

Note: All regressions are in log-log form and include a constant as well as a full set of country-fixed and time-fixed effects. Specification (4) is estimated using centred values (with zero mean) of the variables forming the interaction term. ***,** and * indicate statistical significance at the 1%, 5% and 10% level respectively. Standard errors in parenthesis. Standard errors are clustered and robust to heterogeneity and based on small sample properties. All regressions estimated with STATA using the xtivreg2 command provided by Schaffer (2010).

Our chosen set of instruments is relevant in the sense that they are sufficiently correlated with the endogenous variable (manufacturing aid) as indicated by the *p*-value of the Kleinbergen-Paap test statistic. The null hypothesis that the regression is underidentified is rejected at the 3% level in both the linear model (specification 1) and model with the interaction term (specification 4). Also, the regressions pass the test for overidentification (Hansen's *J*) which is an issue because we have a rather large set of excluded instruments. The set of instruments turns out to be appropriate because the joint null hypothesis of the Hansen-test that the instruments are valid is far from being rejected in both IV-models. The non-rejection of the Hanson test gives us greater confidence in our choice of instruments (see also Baum, Schaffer and Stillman, 2007). This suggests that our instruments are not strongly correlated with the dependent variable from the original model (i.e. value added exports) and therefore correctly excluded from the original regression model. The sole problematic issue in the linear IV-specification is that the instruments though relevant and valid appear to be weak. In fact, the Kleinbergen-Paap F statistic is around 6.4 which is far below the critical value for a maximal IV bias relative to the OLS results of 10%. The Kleinbergen-Paap F statictic performs better in the non-linear model with an F-test statistic of 11 which suggests that the bias in the IV-estimates relative to the OLS results does not exceed 10%. The fact that the size of the estimated coefficient is very similar in both IV-models makes us confident that the bias in the IV-estimates due to weak instruments is not unacceptably large.

It is also important to note that the test for endogeneity of manufacturing aid, which tests the null-hypothesis that the difference in the estimation results between the OLS and the IV regression is not statistically significant, is not rejected at conventional levels of significance. As is generally the case, endogeneity seems to be even less of an issue in the specification with interaction terms which has a p-value of 0.76. We can safely conclude that it is appropriate to stick to the OLS regressions. Nevertheless, the confirmation of our OLS-results by the IV-estimations is reassuring and above all it allows us to give a causal interpretation to the positive effects of manufacturing aid on value added exports.

6. Robustness checks

In this section we report some robustness checks in order to document that our results do not depend on the particular choice of our proxy for export performance, the value added exports (*vax*), and that the results also hold if we estimated a lagged version of our models.

The first robustness check consists of replacing the dependent variable, the value added exports, with value added exports to extra-EU countries (*vax-exEU*), gross exports (*exp*) and gross exports to extra-EU countries (*exp-exEU*) respectively. For the presentation of these robustness checks we keep the specification numbering from the results section. We also report the main results using value added exports as dependent variable for ease of comparison.

The switch of the dependent variable to alternative measures of export competitiveness does not fundamentally change the results. Above all, the general pattern of a statistically significant and positive coefficient of manufacturing aid is maintained with alternative measures of export competitiveness (Table 5).

Table 5

OLS Regression results (fixed effects), alternative measures of export performance

Dependent variable:	**vax**	**vax-exEU**	**exp**	**exp-exEU**	**vax**	**vax-exEU**	**exp**	**exp-exEU**
Specification	(1)	(1')	(1'')	(1''')	(4)	(4')	(4'')	(4''')
aid	0.0574***	0.0905**	0.0554**	0.1100*	0.0671***	0.1016**	0.0689***	0.1220*
	(0.018)	(0.040)	(0.022)	(0.061)	(0.018)	(0.046)	(0.022)	(0.071)
fx	-0.9994***	-1.0783***	-1.1143***	-1.2001***	-1.0232***	-1.1325***	-1.1472***	-1.2706***
	(0.238)	(0.306)	(0.241)	(0.391)	(0.261)	(0.321)	(0.266)	(0.401)
gdp*	0.6279**	-0.5943	0.5317**	-0.1213	0.6356**	-0.5448	0.5475**	-0.1057
	(0.264)	(0.473)	(0.220)	(0.298)	(0.252)	(0.472)	(0.214)	(0.298)
wage	0.7801***	1.1778***	0.6614***	1.2362***	0.7804***	1.2212***	0.6592***	1.3028***
	(0.178)	(0.199)	(0.192)	(0.254)	(0.199)	(0.237)	(0.199)	(0.290)
MS	0.1305**	0.0708	0.1121*	0.0120	0.1357**	0.0851	0.1199*	0.0310
	(0.054)	(0.100)	(0.062)	(0.129)	(0.052)	(0.091)	(0.060)	(0.118)
aid x goveff					0.0859*	0.0739	0.1230*	0.0668
					(0.048)	(0.084)	(0.070)	(0.124)
goveff					0.0285	-0.2280	0.0440	-0.3476
					(0.281)	(0.382)	(0.279)	(0.474)
F-test	82.93	49.27	60.27	76.53	153.03	126.46	146.68	146.41
R^2-within	0.741	0.751	0.778	0.722	0.745	0.754	0.782	0.724
R^2-within adj.	0.726	0.737	0.765	0.706	0.729	0.739	0.769	0.707
obs.	394	394	394	394	394	394	394	394

Note: All regressions are in log-log form and include a constant as well as a full set of country-fixed and time-fixed effects. Specifications (4)-(4''') are estimated using centred values (with zero mean) of the variables forming the interaction term. ***,** and * indicate statistical significance at the 1%, 5% and 10% level respectively. Standard errors in parenthesis. All regressions estimated with STATA using xtreg.

Quantitatively, the coefficients are larger for the export measures that are confined to extra-EU shipments. In the case of value added exports to extra-EU countries the estimated coefficient is 0.91 in the linear model. It is even larger for the variant using extra-EU gross exports as the dependent variable. However, the statistical significance in these cases is lower. One difference between the specifications using extra-EU exports is that the foreign GDP variable does not come out as statistically significant. The reason for this, we believe, is that while the GDPs of individual partner countries used to construct the foreign GDP variable, *GDP**, are weighted with the appropriate trade shares, the indirect exports may play a large role. That is, extra-EU exports (both in gross and in value added terms) may still strongly depend on the GDP growth of and exports to important EU countries such as Germany, the UK or France.

The global value added exports and the gross exports specifications deliver very similar results both quantitatively and qualitatively. This includes a statistically significant interaction term in specification (4) and (4'') which is not found in the extra-EU export specifications. In any case, this robustness check shows that our main results are not driven by our particular choice of the value added exports as the dependent variable.

Table 6

OLS Regression results (fixed effects), various measures of export performance with one period lagged values of the explanatory variables

Dependent variable:	**vax**	**vax-exEU**	**exp**	**exp-exEU**	**vax**	**vax-exEU**	**exp**	**exp-exEU**
Specification	(1)	(1')	(1'')	(1''')	(4)	(4')	(4'')	(4''')
Explanatory variables are one period lagged								
aid	0.0487***	0.0760*	0.0486**	0.0999*	0.0577***	0.0864*	0.0595***	0.1086
	(0.017)	(0.039)	(0.021)	(0.057)	(0.017)	(0.044)	(0.020)	(0.065)
fx	-0.8822***	-0.9580***	-1.0186***	-1.0817***	-0.9056***	-1.0002***	-1.0446***	-1.1302***
	(0.223)	(0.267)	(0.218)	(0.324)	(0.236)	(0.281)	(0.229)	(0.344)
gdp*	0.5232**	-0.5364	0.3260*	-0.1356	0.5254**	-0.4967	0.3353*	-0.1249
	(0.203)	(0.436)	(0.175)	(0.317)	(0.198)	(0.429)	(0.176)	(0.314)
wage	0.6463***	0.9744***	0.5351**	0.9756***	0.6525***	1.0046***	0.5374***	1.0214***
	(0.182)	(0.194)	(0.195)	(0.253)	(0.194)	(0.219)	(0.191)	(0.277)
MS	0.1384***	0.0724	0.1144*	0.0247	0.1446***	0.0839	0.1217**	0.0379
	(0.049)	(0.088)	(0.058)	(0.115)	(0.049)	(0.084)	(0.059)	(0.108)
aid x goveff					0.0715*	0.0711	0.0907	0.0470
					(0.042)	(0.068)	(0.059)	(0.094)
goveff					-0.0119	-0.1533	0.0056	-0.2372
					(0.252)	(0.308)	(0.241)	(0.339)
F-test	22.58	48.53	35.85	31.53	54.23	113.73	63.17	47.64
R^2-within	0.706	0.732	0.760	0.707	0.709	0.734	0.764	0.709
R^2-within adj.	0.689	0.716	0.747	0.691	0.691	0.717	0.749	0.690
obs.	367	367	367	367	367	367	367	367

Note: All regressions are in log-log form and include a constant as well as a full set of country-fixed and time-fixed effects. Specifications (4)-(4''') are estimated using centred values (with zero mean) of the variables forming the interaction term. All specifications use one-period lagged versions of the independent variables. ***,** and * indicate statistical significance at the 1%, 5% and 10% level respectively. Standard errors in parenthesis. All regressions estimated with STATA using xtreg.

In the context of industrial policy there is always the issue of the time lag between implementation of the respective support measure, here the provision of subsidies, and the date when the measure takes effect. For example, Buts and Jegers (2013) find that the positive effect of Belgian firms receiving state aid on their market share takes effect only with a lag of two years. In our data this is not the case as we find statistically significant effects of manufacturing aid already with contemporaneous values of our explanatory variables. The reason for the difference in results could be explained by the fact we are using sector-level data whereas Buts and Jegers (2013) undertake their analysis at the firm level. We nevertheless check the effects of state aid with lagged variables which are summarised in Table 6.

The estimated coefficients of manufacturing aid with one-period lagged explanatory variables are smaller and most of them have lower statistical significance than in the contemporary specifications throughout the regressions. Also, the interaction term in the specification with gross exports (specification 4'') loses its statistical significance. The results get even weaker when we estimated the models with two-period lagged explanatory variables. This leads to the conclusion that state aid measures for the manufacturing sector take effect without long delays and that this stimulating effect on export performance levels off over time.

7. Conclusions

Industrial policy is still considered with a lot of scepticism in large parts of Europe due to its disappointing track record. There is, however, a renewed interest in industrial policy that has been nurtured by the long-term shift out of manufacturing in the EU and intensified by the still sluggish growth since the outbreak of the economic crisis. Motivated by the revived debate on industrial policy we investigated the impact of state aid to the manufacturing sector on the sector's export performance for 27 EU Member States over the period 1995-2011. We test three hypotheses which are *(i)* the provision of manufacturing aid supports export competitiveness; *(ii)* the marginal effect of manufacturing aid on exports is declining with the amount of state aid and may even turn negative and *(iii)* state aid provided by countries with high government effectiveness has a larger impact on export performance.

Using manufacturing value added exports as a proxy for external competitiveness we find that a 10% increase of manufacturing aid is associated with an increase of value added exports of 0.56%-0.67% for the average Member State which is in line with hypothesis 1. We also find mild support for the third hypothesis that the effect of state aid on export performance is stronger the higher a country's government effectiveness. Hence, for the Nordic countries, which score highest in terms of government effectiveness, we find elasticities of manufacturing aid with respect to value added exports exceeding 0.08 whereas for Romania, which has the lowest government effectiveness score among the 27 EU Member States, the effect of state aid on value added exports conditional on government effectiveness is only about 0.024.

In order to eliminate the possibility of reverse causality we employ an instrumental variable approach. The positive effect of manufacturing aid on export performance is confirmed by the IV-results suggesting now that a 10% increase in manufacturing aid leads to an expansion of value added exports by 1.1% which is a considerably larger effect than in the OLS model. However, the endogeneity test performed does not suggest that endogeneity of manufacturing aid is a particularly relevant issue. Therefore we stick to the OLS model as our preferred model. The confirmation of the results by IV-regressions is useful, however, since it allows us to give a causal interpretation to the positive correlation we find between manufacturing aid and value added exports.

We do not find empirical support for the hypothesis that the marginal effect of manufacturing aid on value added exports declines as the amount of state aid increases. The explanation for this may be that the amounts of aid currently involved are rather low by historical standards and therefore below the threshold where diminishing returns from the provision of state aid sets in.

Our results therefore strongly suggest that industrial policy and the use of state aid can serve as an effective tool to foster exports. According to our estimates one million of additional aid to the manufacturing sector leads to an increase of manufacturing value added exports of 1.37 million for the average EU Member State. However, we also find that the leverage of state aid to promote export varies considerably across Member States. An important aspect here is that, in general, the countries with less competitive manufacturing sectors also have lower state aid leverage with respect to exports. We interpret this as an argument in favour of more industrial policy activism at the EU level because it may remedy some of the shortcomings of the national industrial strategies such as inefficient government structures.

Overall our results build a case for more active industrial policy in Europe both at the national and at the EU level. This very strong result may be partly due to the particular situation in the EU where sovereign governments agreed to have their state aid activities supervised and controlled by the European Commission which most probably has contributed to the quality and effectiveness of the subsidies provided. However, a word of caution needs to be added at this stage. While we found state aid to be supportive of manufacturing exports we do not suggest that subsidies are a magic bullet for export competitiveness. After all, diminishing returns from subsidies are likely to set in if state aid were to be increased dramatically even though we find no statistically significant result for that at the current levels of aid. Moreover, it should be kept in mind that a subsidy-induced export stimulus comes at a cost – a cost that is to be borne by taxpayers.

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